The Open University

ERRATA

Faculty of Science

SMT359 ELECTROMAGNETISM

Please mark module materials with the following corrections immediately.

'Various integrals' list at back of Books 1, 2 and 3

Please add: "$\int \frac{x}{\left(a^2+x^2\right)^{\frac{1}{2}}}\,\mathrm{d}x = (a^2+x^2)^{\frac{1}{2}}$".

Book 1

Page 116, equation on line 12. Please note that there is a missing $\delta\phi$ in the last term of the equation. (Please see equation 8.19 on page 208 where this equation is printed correctly.)

Page 130, line – 8. This should read: "Integrating over the entire disk, using one of the standard integrals listed inside the back cover, the potential ….".

Page 131, line 5. This should read:

"$(1 + (R/z)^2)^{-1/2}$……."

Page 156, left hand side margin. This should read: "See also Exercise 8.29."

Page 162, line 19. Please note that in the equation div $\mathbf{B} = \mathbf{0}$, the zero should not be bold.

Page 173, right hand side margin. This should read: "See Chapter 2, Section 2.3.3."

Page 178, line 7. The equation should read:

"curl $\mathbf{E} + \frac{\partial \mathbf{B}}{\partial t} = \mathbf{0}$."

Page 186. Delete the margin note, and change "energy flux" to "energy flux density" four times in the last four lines on this page.

Page 187. Change "energy flux" to "energy flux density" in Equation 7.31 and two lines below this equation.

Page 188, Paragraph 2, line 4. This should read: "Lorentz insisted that charge and current densities are the *only* sources…"

Page 209, line – 4. For "cube", read "cuboid".

Page 233, Figure 8.39. In this figure, the four arrow heads at the bottom of the bell-shaped surface should have their direction reversed.

Page 235, line – 4. This should read:

"… from y to $y + \Delta L$."

Page 258, Ex 3.12(a), line 7. This should say…"electric field now points from left to right, as required."

Page 261, Ex 5.2, *Comment* line 3. This should read: “decreases without limit as r increases.”

Page 261, solution to Exercise 5.4. All of the terms in the last two lines on p261 should be preceded by a minus sign.

Page 263, Ex 6.4, line 2. This should read: “$V / (R + r) =$…”

Page 264, Ex 6.9, line – 2. This should read:

"$\mathbf{B} = \dfrac{Ak}{\omega} \cos(ky - \omega t)\mathbf{e}_x + \mathbf{B}_0$,"

Page 265, solution to Exercise 7.8. Change "energy flux" to "energy flux density" in line 1 of the solution and in the first line of the comment.

Book 2

Page 34, Section 2.5, 2nd paragraph, line 3. This should read: "$\oint_C \mathbf{E} \cdot d\mathbf{l} = -\int_S \cdots$"

Page 49, 2nd paragraph below Table 3.2, line 2. This should say: "… isotropic because **M** is in the same direction as **B** if χ_B is positive and in the opposite direction to **B** if χ_B is negative, and homogeneous…"

Page 54, line 3. This should read: “… unknown quantities, **B** and **M**, …”

Page 54, line 5, Equation 3.6. This equation should read:

"$\mathrm{curl}\left(\dfrac{\mathbf{B}}{\mu_0} - \mathbf{M}\right) = \mathbf{J}_\mathrm{f}$."

Page 64, line –4. This should say: "…, **M** is in the same direction as **B** if χ_B is positive and in the opposite direction to **B** if χ_B is negative, and χ_B is independent of position."

Page 78, orange box. The fourth line should read: “…component of the gradient of the potential …”

Page 86, Exercise 4.8, part (b). The first line of part (b) should say: "Use conditions (ii) and (iii) to find values for A_2 and B_1."

Page 88, line 11. This should read: “$V(x_i, y_j) = \dfrac{1}{4}$ …..”.**(new 7/8/12)**

Page 94, Figure 5.2b. In the last equation, replace $\mathbf{e}_z$ with $\mathbf{e}_\phi$.

Page 110, Figure 5.18. The grey arrows in Figure 5.18(b) and 5.18(c) should meet at the centre of the sphere, as stated in the caption and in the text.

Page 124, line 4. This should say: "…$q\Delta V$ = 500 eV, i.e. 1 keV per orbit."

Page 144, line 14. Delete "Assuming that Ohm's law, $V = IR$, is valid." Even when Ohm's law is not valid (so that R is not constant but depends on V and I), we can still define a resistance by $R = V/I$, and the three expressions for the power dissipated are all valid.

Page 158, line 18. The equation should read: "$= -\dfrac{\mathrm{d}}{\mathrm{d}t} \oint_S \mathrm{curl}\,\mathbf{A} \cdot \mathrm{d}\mathbf{S} = ...$"

Page 189, 5th displayed equation. This should read: "$U = \frac{1}{2} \int_\tau \mathbf{D} \cdot \mathbf{E}\, \mathrm{d}\tau$."

Page 190, line 2. The equation should read: "$U = \frac{1}{2} \int_\tau \mathbf{B} \cdot \mathbf{H} \mathrm{d}\tau$.

Page 199, line 14. This should say: "…that is, $\partial\mathbf{B}/\partial t = \mathbf{0}$."

Page 217, Section 9.4, line 10. For "course" read "coarse".

Page 227. In Figure 10.8 the force vector should be in the $\mathcal{F}'$ frame, so it should be labelled $\mathbf{F}' = (F_x', F_y', F_z')$

The caption to Figure 10.8 should read:

"In frame $\mathcal{F}'$, an observer measures a force $\mathbf{F}'$ acting on a particle. What force would be measured by an observer in frame $\mathcal{F}$?"

The second sentence under Figure 10.8 should begin:

"If a particle at rest in frame $\mathcal{F}'$ is subject to a force $\mathbf{F}'$, then …"

Page 235, Figure 10.12. The RHS of this figure should say: "gradient operator in frame $\mathcal{F}$ " (not $\mathcal{F}'$).

Page 247, line 3. This should read: "… and curl $\mathbf{H} = \mathbf{J}_\mathrm{f}$"

Page 260, Ex 6.5, line 13. This should say: "$\times$ 1.38 $\times$ 10^{-23} J K^{-1} $\times$…"

Page 269, Ex 10.4, last line. This should read: " = – 1.8 mA m^{-2}".

Book 3

Contents page, the title should read "Electromagnetic waves" (not "EMF").

Page 56, line –4. This should say: "… varies as sin θ / r, …"

Page 60, line 2. The RHS of the equation should read: " $= \int -n\sigma \mathrm{d}z$".

Page 66, line –3. This should read: … and $\mathbf{J}_\mathrm{f} = \mathbf{0}$, …"

Page 76, Equation 3.19. In the first line of this equation, the first term in the second exponent should read: "……exp[i($\mathbf{k}_r \cdot \mathbf{r}$….", (i.e. delete the minus sign).

Page 95, line 3. The first line in the box should read: "…$\varepsilon(\omega) = \varepsilon_{\text{real}}(\omega) + \text{i}\,\varepsilon_{\text{imag}}(\omega)$"

Page 103, line 4−5. The first line after the blue box should read:

"Similar arguments show that $\mathbf{E}_{\text{sum}}$ and $\mathbf{B}_{\text{sum}}$ also obey Gauss's law and the no-monopole law. However they do *not* satisfy the Ampère-Maxwell law because the permittivity is different for the two frequencies ω_1 and ω_2 of the solution pairs $\{\mathbf{E}_1, \mathbf{B}_1\}$ and $\{\mathbf{E}_2, \mathbf{B}_2\}$. As a consequence, they do *not* generally obey a wave equation, as …"

Page 103, the first bullet point in the yellow box should read: "any linear combination of plane wave solutions of Maxwell's four equations – involving waves of different frequencies − is itself a solution of Gauss's law, the no-monopole law and Faraday's law, but not of the Ampère-Maxwell law;"

Page 123, Figure 5.3. The visible light spectrum in Figure 5.3 is the wrong way round. The red frequencies should be adjacent to the infrared frequencies and the violet frequencies should be adjacent to the ultraviolet frequencies.

Page 142, lines 6 and 7. These should say: "… of the boundaries at $x = 0$ and $x = b$, …".

Page 167, line −7 and line −9. Replace "Subsection 6.2.1" with "Subsection 6.1.7" in both cases.

DVD 2

In the notes for video "Bending magnets" on DVD 2 (associated with Chapter 6 of Book 2), page 4, Solution 3, the equation for the focal length of the magnet should contain the factor $1/gl$ and not g/l. The equation was shown correctly on page 1 and the calculated answer is correct.

In the notes for video "Absorption of electromagnetic waves "on DVD 2, Solution 3 should read: …"Using $\delta = \sqrt{2/\mu\mu_0\sigma\omega}$, we find $\delta = 0.008$ mm at 100 MHz, and $\delta = 0.18$ mm at 200 kHz. If the foil thickness is 0.1 mm, then the 100 MHz signal is attenuated by exp $(-y/\delta)$ ~ exp (−12.5) ~ 4×10^{-6}, and the 200 kHz signal by exp (−0.56) ~ 0.6…"

Additional Exercises

Page 18, Solution 2.10. Line 15 should read:

$$“ -\frac{\rho d}{2\varepsilon_0}\mathbf{e}_z \qquad \text{for} \quad z < -\frac{d}{2}. ”$$

Page 32, Solution 5.4(b). This should read:

"(b) Using the differential version of Ampère's law,

$$\mathbf{J} = \frac{1}{\mu_0}\,\text{curl}\,\mathbf{B}$$

$$= \frac{1}{\mu_0} \begin{vmatrix} \mathbf{e}_x & \mathbf{e}_y & \mathbf{e}_z \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ az & ax & ay \end{vmatrix}$$

$$= \frac{a}{\mu_0} (\mathbf{e}_x + \mathbf{e}_y + \mathbf{e}_z)$$”